DOCUMENT RESUME

ED 302 681 CE 051 685

AUTHOR Packer, Arnold H.
TITLE Retooling the American Workforce: The Role of Technology in Improving Adult Literacy during the 1990s. Background Paper Prepared for Project on Adult Literacy.
INSTITUTION Southport Inst. for Policy Analysis, Inc., CT.
PUB DATE Dec 88
NOTE 79p.; For related documents, see CE 051 679-686.
AVAILABLE FROM The Project on Adult Literacy, Suite 415, 440 First Street, N.W., Washington, DC 20001.
PUB TYPE Information Analyses (070)

EDRS PRICE MF01/PC04 Plus Postage.
DESCRIPTORS *Adult Basic Education; *Adult Literacy; Computer Assisted Instruction; Cost Effectiveness; Delivery Systems; Educational Change; *Educational Technology; Federal Government; *Futures (of Society); Government Role; *Literacy Education; Microcomputers; Program Costs; *Program Improvement

ABSTRACT

An estimated 25 million American workers will need to upgrade their skills during the 1990s if the U.S. economy is to stay competitive. The contribution of computers and electronic technology to productivity in education still remains to be proved. In the 1990s, technology for adult basic skills training will mean interactivity, multimedia, and sufficient record keeping so as to improve instructional methodology. Without appropriate courseware to provide specified upgrading of skills, electronic technology is useless. When selecting educational technology to use in workplace literacy programs, directors must consider the size and expected life of the program, the leadership strategy adopted, and the resultant per-unit cost of instruction. Workplace literacy programs should be designed around a flexible technology-based system that would allow course materials to be "transportable" across different hardware systems and that would give providers the flexibility to invest in technology and use it to serve clients from different programs in the same class. It has been projected that a total investment of about $3.5 billion could serve 25 million workplace learners over the next decade. (An appendix discusses how much technology can cost while still resulting in cost savings for a course.) (MN)

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RETOOLING THE AMERICAN WORKFORCE: THE ROLE OF TECHNOLOGY IN IMPROVING ADULT LITERACY DURING THE 1990s

by

Arnold H. Packer
Interactive Training, Inc.

Background Paper Prepared for

Project on Adult Literacy

of the

Southport Institute for Policy Analysis

December 1988

CE051685

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FOREWORD

This paper is one of several prepared by consultants to The Project on Adult Literacy sponsored by the Southport Institute for Policy Analysis. The papers were commissioned to help the Project's staff develop an in-depth understanding of various issues and perspectives bearing on the federal role in promoting adult literacy.

In total, seven papers were commissioned. They were prepared during the fall of 1988. The consultants who prepared them met as a group five times during that period and vigorously debated each other's work as well as other issues concerning adult literacy. At no time during this process did the Project's staff require that the consultants agree with each other or with the conclusions being formulated by the staff. The consultants were given complete freedom to state their own ideas.

As a result, the views expressed in this paper are those of the author alone. They do not necessarily reflect the views of the Southport Institute, the Project on Adult Literacy or any of the other consultants involved with the Project's work.

The Southport Institute is making these working papers available to help increase understanding and stimulate discussion about the problems of adult literacy and as an expression of gratitude for the contribution of the authors to the Project on Adult Literacy.

The working papers prepared for the Project are:

Judith A. Alamprese:	Adult Research and Development: An Agenda for Action
William B. Bliss:	Providing Adult Basic Education Services to Adults with Limited English Proficiency
Jack A. Brizius:	The State Role in Adult Literacy Policy
Paul V. Delker and William J. Yakowicz:	Toward the Vision of a Literate Society
Susan E. Foster:	Professionalization of the Adult Literacy Workforce
Arnold Packer:	Retooling the American Workforce: The Role of Technology in Improving Adult Literacy During the 1990s
William F. Pierce:	A Redefined Federal Role in Adult Literacy: Integrated Policies, Programs, and Procedures

These papers are available from: The Project on Adult Literacy, Suite 415, 440 First Street, N.W., Washington, DC 20001, (202) 783-7058.

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RETOOLING THE AMERICAN WORKFORCE

by

Arnold H. Packer

I. HYPOTHESIS

Twenty-five million American workers need to upgrade their skills during the 1990's. Otherwise the U.S. economy will become less competitive and fail to grow adequately. Most of the 25 million will not have attended college; they tended to be the "forgotten half" in school and, if employed, ignored by company-sponsored training programs. If their skills are not improved, wage inequality and the underclass will expand further.

According to research at the Hudson Institute, these 25 million need to improve their workplace literacy and related skills by almost 40% on average.1/ The goal can only be achieved by widespread and cost-effective use of technology and by rethinking who, what, where and how training is accomplished.

The contribution of computers and electronic technology to productivity in education still remains to be proven. For twenty years, promises have outstripped reality. One miracle machine after another has ended up in the closet or "audiovisual room" collecting dust, while teachers continue to use pencil and paper, textbooks and blackboards.

Many of us are convinced that this time it will be

different; that the last decade of the 20th century will see a revolution in the way children and adults learn. A recent study by the Congressional Office of Technology Assessment (OTA) surveyed the situation for elementary and high schools (K-12 in the educator's jargon)2/. They are optimistic that the information revolution that has so profoundly affected American business is catching on in K-12, though much more has to be done. Almost all schools (95%) have at least one computer and, on average, there is one computer for each 30 public school students. 3/ Skeptics may hold that these numbers more reflect the marketing prowess of the computer companies then the proven results of their products. The OTA report, however, makes a convincing case for the machines so far; it also predicts a future based on continuing improvements in hardware and software and a better understanding of the learning process.

The subject of this report, however, is not computers in offices or K-12 classrooms; it is computers and other electronic technology in training rooms and classrooms for youth and adults seeking to improve their basic workplace skills. What are those skills and how deep is the deficiency?

II. DEFINITIONS AND DIMENSIONS OF THE PROBLEM.

A. What Are Adult Basic Workplace Skills?

A useful definition of workplace skills, for the purposes of this paper on technology, has to be operational enough to guide the development and evaluation of technology-based courses. Such operational definitions are not yet available. Adult programs and program analysts use measures they know to be inadequate, such as the TABE (Test of Adult Basic Education). The following are considerations that may be helpful in the development of operational definitions and performance measures.

Basic workplace skills include basic literacy (decoding), communication skills for native and non-native English speakers, and problem-solving in job-related contexts. There is no single measure of these skills. Life, and literacy, is too complex to be captured on a single scale.

E.D. Hirsch, Jr. has written a best seller entitled Cultural Literacy.4/ He makes the fundamental point that, after basic decoding, literacy is only meaningful in context. This suggests that "grade level" literacy is meaningless. It also suggests that a set of universal skills are a chimera. Moreover, the research on adult learning suggest that context-free (or inappropriate context) instruction will not work.

Larry Mikulecky and Tom Sticht also argue that, because grade level achievement is uncorrelated with work performance, workplace literacy must be taught -- and measured -- in context. Sticht draws the following wonderful picture. "Think," he says, "of a basin of basic literacy containing leaky test tubes of context-relevant literacy skills. It is much more effective," says Sticht, based on his experience with training programs in the Navy, "to fill the test tubes and let it leak into the basin then to fill the basin and let it transfer into the tubes."

Humans are problem-solvers as they seek to meet their needs (from survival needs to self-actualization, according to Maslow). The problem (or need), for most schoolchildren, is passing with high-enough grades. Thus, "skills" are taught with an "applications" section tossed in at the end of the course and youngsters moan "why learn this"? (How often does anyone want to solve those typical high-school algebra problems to find when trains leaving from Chicago and New York will meet.)

The better instructional design is to start with the problem and then teach the skills needed to solve it. Dr. John Henry Martin's courses exemplify this approach. The student's problem in "Writing-to-Read," his successful program now being used by 600,000 pre-schoolers and first-graders, is to write a composition. Students communicate

what is in their heads, not what is in the teacher's syllabus. (Martin has also developed PALS, Principles of Alphabet Literacy Systems, for adults of very low literacy.) A typical grade-level word recognition test, based on the vocabulary of first grade primers, will not measure this skill.

Sticht, Mikulecky, Martin, Hirch, and many other researchers suggest that adult literacy is best taught -- and, thus, measured -- in the context of realistic problems. The issue is how narrowly the problems are defined and how transferable are the skills learned. The vocational areas shown in Table I suggests a workable solution. The proposed solution avoids two equally unworkable alternatives:

a. "One size fits all" in some context-free generic skills program; and

b. "Every situation is different" and a new literacy has to be defined for each of the 12,000 jobs in the Dictionary of Occupational Titles that is maintained by the U.S. Department of Labor (DoL).

A series of skills are needed within each job category of Table I. Generally, to be "basic," a skill should be needed by many workers (e.g., a million or more adult/youth non-college students during the next decade). This implies that skills are transportable beyond narrowly defined job categories.

TEN TYPICAL JOB CLUSTERS AND UPGRADING SKILLS
(Tentative until a literacy audit is undertaken)

Clusters and Jobs	Upgrading Skills
1. Health and Dependent Care Health care, child care, nursing homes, home care, elder care.	Patient/client registration, administer medicine, keep records, respond to inquiries, fill out insurance forms.
2. Construction/Maintenance Small and large contract construction, building and facility maintenance.	Read blueprints and maintenance manuals, understand cost estimates, follow directions.
3. Office Skills: Financial, commercial, and manufacturing offices.	Understand business forms (payroll, insurance, memos etc.). Computer literacy. Oral communications skills.
4. Financial Services: Insurance, banks, real estate.	Read instructions, handle forms, understand business math.
5. Retailing: Sales, customer service, inventory control.	Read and communicate directions, understand forms (sales slips, invoices).
6. Distribution: Warehousing, truck driver, delivery, dispatcher.	Read maps, follow directions, use forms (invoices, logs, police reports).
7. Manufacturing: Machine operator, quality control, inventory control.	Read instructions, quality control, math, production schedules, computer-controlled equipment.
8. Food Service: serving, preparing, cashier.	Read menus, make out a bill, make change, follow a recipe.
9. Hotels/Hospitality: Housekeeping, quest services.	Understanding English, answering requests, guest registration.
10. Equipment Repair and Maintenance.	Maintenance manuals, filling out logs, answering complaints.

In most cases there will be entry-level and career ladder positions and, often, entrepreneurial possibilities as well.

Table I

The Educational Testing Services' (ETS) recent National Assessment of Educational Progress (NAEP) study, Literacy, Profiles of America's Young Adults, made a very significant step toward defining basic skills5/. Rather than using grade levels, ETS identified prose, document, and numerical literacy as basic. ETS focussed on skills that are more general than those needed on the job and specified in Table I; e.g., the respondents were asked to use a menu, not create one. Further effort will be undertaken to increase the workplace focus under a DOL contract with ETS to extend their NAEP work to provide useful measures of workplace literacy.

DoL has defined workplace skills, from basic through advanced. They have established a language and a math scale, each containing six levels, and applied them to the 12,000 jobs in the Dictionary of Occupational Titles. Table II is a brief description of the DoL's language scale.

The recommended solution is to build on the NAEP and DoL scales to create a scale for each of the job clusters shown in Table I. Building a scale requires a "literacy audit" for representative jobs in the cluster. The Bottom Line, a recent joint publication of the Departments of Labor and Education, lays out the procedure for such an audit.6/ DoL has funded two audits which are now in process.7/

DEFINITION OF GED LANGUAGE SCALE*

LEVEL	LANGUAGE DEVELOPMENT
1	Reading: Recognize meaning of 2,500 (two- or three-syllable) words. Read at a rate of 95-120 words per minute. Writing: Print simple sentences containing subject, verb, and object and series of numbers, names and addresses.
2	Reading: Passive vocabulary of 5000 to 6000 words. Read at a rate of 190-215 words per minute. Read adventure stories and comic books, looking up unfamiliar words in dictionary for meaning, spelling and pronunciation. Read instructions for assembling model cars and airplanes. Writing: Write compound and complex sentences, using cursive style, proper end punctuation, and employing adjectives and adverbs.
3	Reading: Read a variety of novels, magazines, atlases, and encyclopedias. Read safety rules, instructions in the use and maintenance of shop tools and equipment, and methods and procedures in mechanical drawing and layout work. Writing: Write reports and essays with proper format, punctuation, spelling and grammar, using all parts of speech.
4	Reading: Read novels, poems, newspapers, periodicals, journals, manuals, dictionaries, thesauruses, and encyclopedias. Writing: Prepare business letters, expositions, summaries, and reports, using prescribed format, and conforming to all rules of punctuation, grammar, dictions, and style.
5	Same as Level 6.
6	Reading: Read literature, book and play reviews, scientific and technical journals, abstracts, financial reports, and legal documents. Writing: Write novels, plays, editorials, journals, speeches, manuals, critiques, poetry, and songs.

Table II

* Source Department of Labor

B. How Big Is the Basic Skills Gap?

"Today, American workers are the most productive in the world. But unless the nation's 'workplace literacy' is upgraded markedly, we will lose that distinction by the year 2000..."8/. Comparing a forecast of the skill requirements of tomorrow's economy to a survey of the skills possessed by today's young persons leads to this conclusion.

Tomorrow's skill requirements come from projections in Hudson Institute's Work Force 2000 report 9/; the estimate of the skills possessed by today's 21 to 24 year olds come from the previously cited NAEP survey. (NAEP measured attainment of prose, document, and quantitative skills among 3600 21- to-25 year olds and found that most of those surveyed possessed basic literacy, but not higher order thinking skills.)

A comparison of the NAEP survey and the Work Force 2000 projections provides a conservative estimate that 25 million workers need to upgrade their basic workplace skills in the decade of the 1990's, if the Work Force 2000 productivity goals are to be met. The 25 million may well be a low estimate. First, Hudson's projections are based only on the changing mix of jobs, not the changing requirements in any particular job. Second, the NAEP survey was one of

households, missing the institutionalized and street population.

Figure 1 is a snapshot of the needs based on the Hudson/NAEP reports. Notice that the basic literacy problem, between levels one and two, is relatively small (although this is the area where the NAEP procedure most likely understates the problem most.) The largest number of potential trainees have skills between levels two and three on the scale. About 18 million of the potential trainees have the modest skills implied by level two but are not up to the moderate skills of level three.

The average improvement required is from 2.6 to 3.6, an improvement of 38%, based on the DoL scale. That is, 25 million adults require an improvement of one DoL skill level, in context, during the next decade.

C. Who Funds Adult Basic Skill Programs and Who Delivers the Services?

The delivery of adult literacy instruction is financed in many ways (see Figure 2). In the private sector these include corporate-financed human resource programs, union programs, and joint union-management programs. The latter are exemplified by the so-called "nickel funds" in the auto industry (beginning in 1982, major auto companies contributed a nickel for each hour worked by a UAW member to

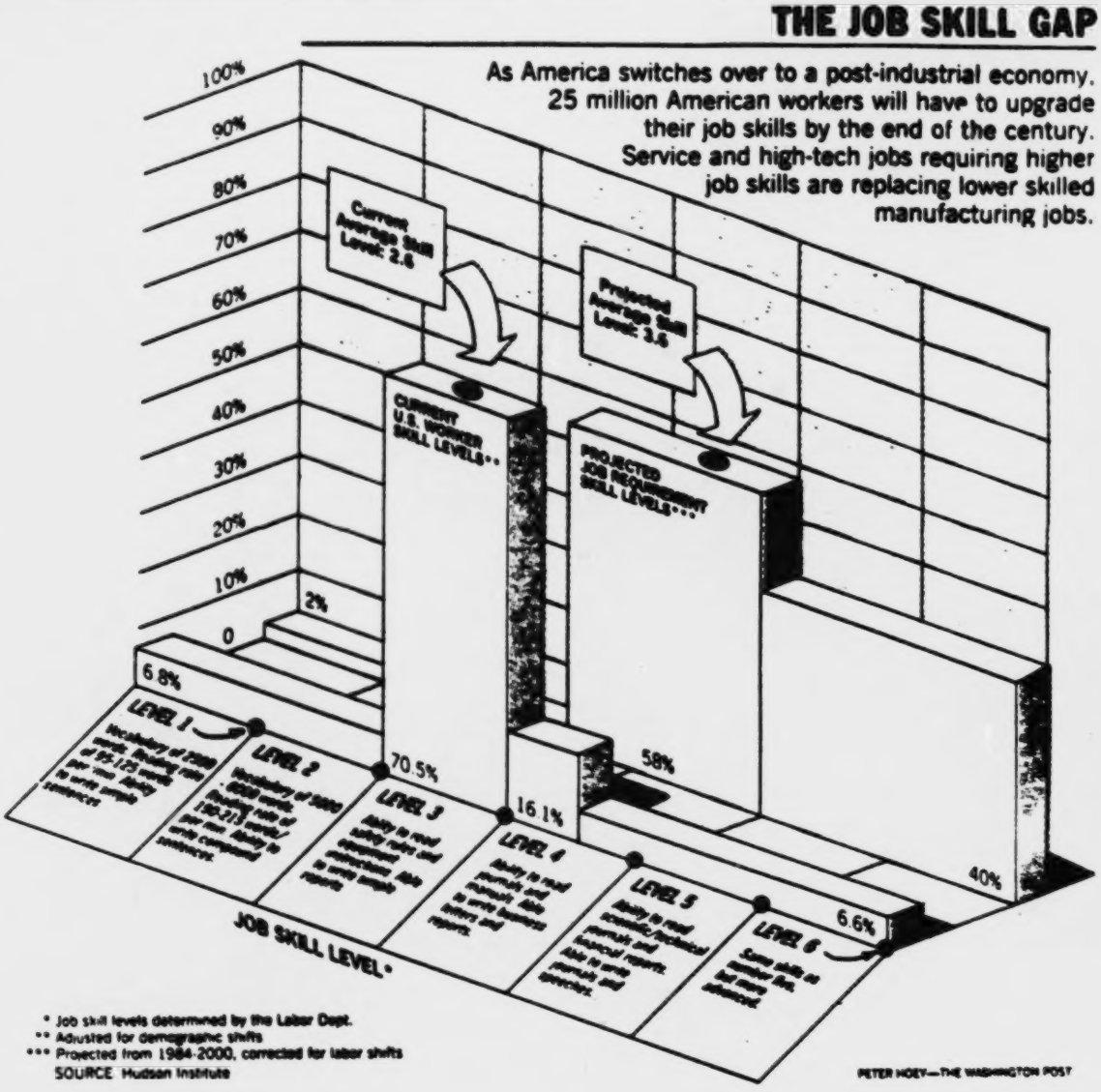

FIGURE 1

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a training fund). In addition, private contributions of money and time provide resources for volunteer programs that deliver services.

Existing federally-funded programs include the Adult Education Act (commonly called ABE) and Vocational Education; DoL-financed employment and training programs, primarily the Job Training Partnership Act (JTPA); and programs for immigrants (IRCA). New legislation in the trade bill (the new Economic Dislocation and Worker Adjustment Assistance Act for dislocated workers) and in the welfare reform bill (the Family Support Act of 1988 authorizes JOBs, a basic skills training for welfare recipients) will increase spending for these programs significantly in the 1990's. In addition to these federal funds, many states spend their own money for adult education, for those on welfare and for the incarcerated.

Few of these federal programs provide services directly (the Job Corps, part of JTPA, is an exception); instead, they provide money to teaching or training organizations; i.e., to the service providers. Adult schools, community-based organizations (e.g., SER and OIC), community colleges, prisons, union halls, and welfare offices provide instructional services. In addition, companies and institutions (e.g., hospitals) may provide

The Funding Programs

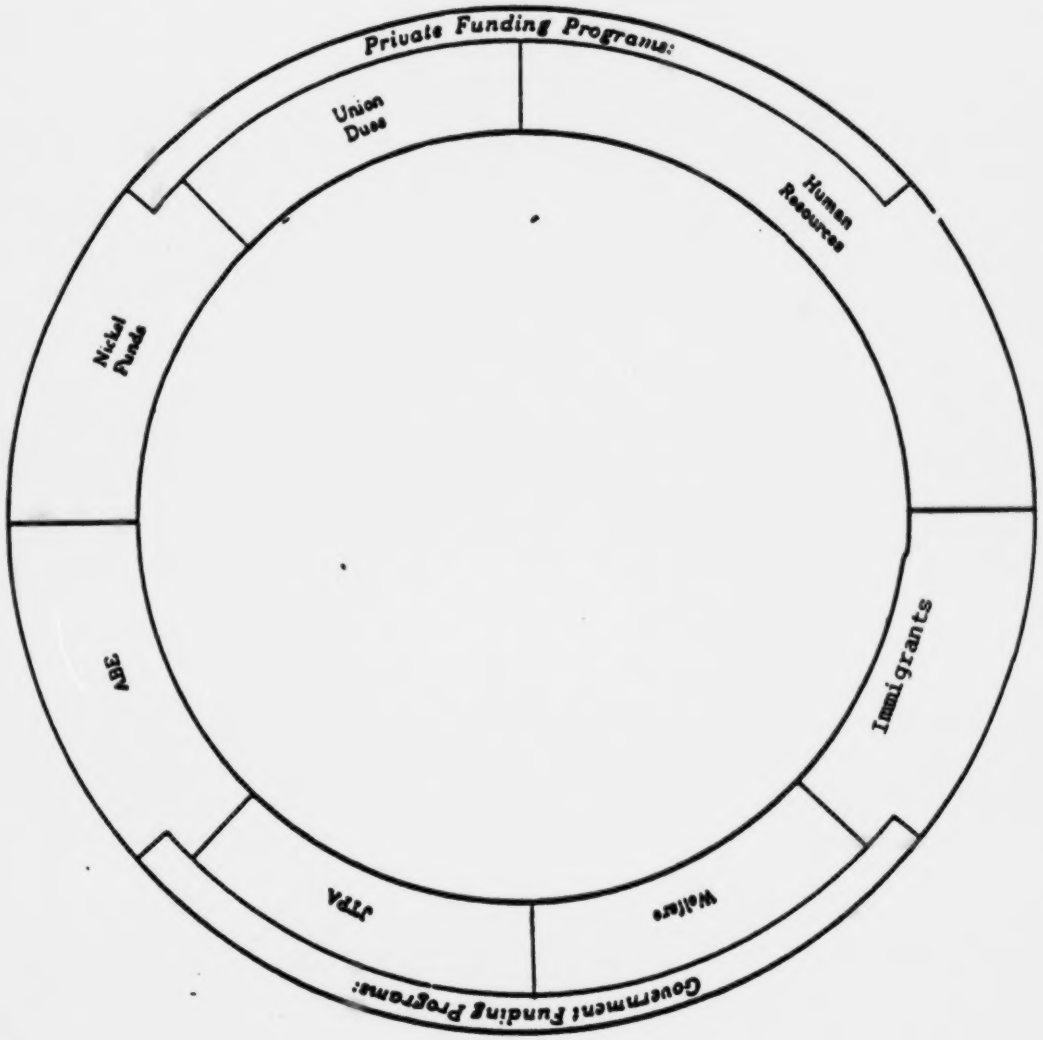


Figure 2

training on-site for their employees. The service providers are depicted in Figure 3.

Providers of instructional services may be funded by more than one program or source of financing. Enrollees in ABE programs are served by local school systems; but schools also receive funds from JTPA. On the other hand, many funding programs use a number of providers. For example, JTPA funds community-based organizations, community colleges, public high schools, and even corporations through On-the-Job-Training (OJT) arrangements.

JTPA funds do not flow directly from the federal government to the service providers. A complex formula, based on changing statistics (such as local unemployment rates) directs funds to Service Delivery Area (SDA's) that correspond to political jurisdictions. Each SDA has a Private Industry Council (PIC), composed of local business, labor, and government representatives. PICs act as a Board of Directors for the SDA.

The dislocated worker program, Title III of JTPA, operates through new substate areas which may or may not be the SDA structure. The welfare training will be another system with welfare agencies and the Department of Health and Human Services (HHS) playing the roles that the SDAs and DoL play in JTPA.

The Service Providers

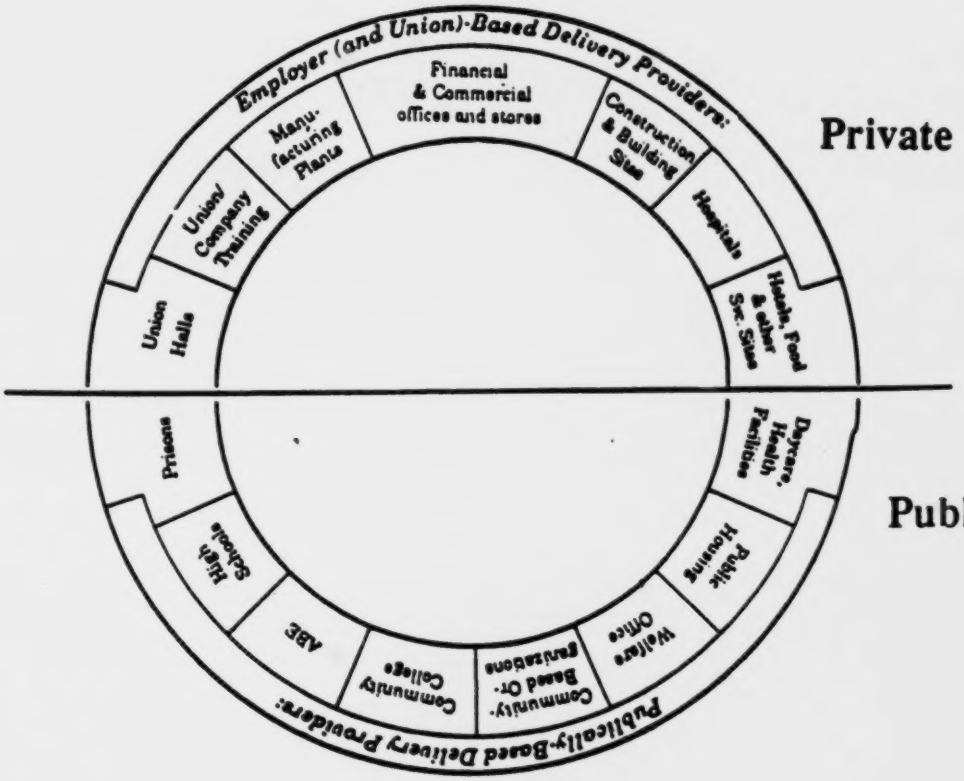


Figure 3

The service providers spend the funds of the federal, state, local, corporate, and union programs. A provider's students may be employees of a private firm or government agency, unemployed enrolles in JTPA, or on welfare, or dislocated workers.

The service providers choose between open-exit, open-entry and scheduled instruction; make the training decisions for their staff, the rules for the student, set the schedules, etc. They choose the furniture, decide on the requirements and, in general, determine whether the technology works or not.

The funding programs set the incentives and the rules under which the providers operate. Programs may encourage (or require) partnerships at the provider level. Examples are OJT contracts found so often in JTPA and the Department of Education's new program that requires partnerships between the private sector and an education agency.10/ The funding programs may also discourage needed partnerships by, for example, requiring overly strict accounting. Then, a computer lab funded with JTPA money cannot serve ABE or welfare recipients.

Any attempt to bring technology to bear on increasing literacy and other basic skills must recognize the difficulties created by this complex decision structure. Funding for local programs rises and falls independently of

performance; few can initiate change but many can veto it; and as much managerial energy goes into fighting regulations as into delivering instructional services. One result is the energy applied to receiving unencumbered grant funds from the government or a foundation rather than relying on normally budgeted funds. This procedure suffices for experiments but will not work if 25 million adults are to be upgraded in the next decade with efficient use of modern technology. If technology is to be optimally used, program legislation and regulations will have to be modified so that service providers are more able to invest in hardware and technology-supported courses.

D. What Is Technology for Adult Instruction in the 1990's?

By the mid-1980's computers were used in the majority of JTPA SDA's for either instruction or management of instruction.11/ The Comprehensive Competencies Program (CCP) is the most widely used system for managing JTPA instruction. Developed by the Remediation and Training Institute with funding support from the Ford Foundation, CCP is now marketed by the U.S. Basic Skills Investment Corporation. It is used by over 250 JTPA service providers to manage computer-based instruction in a self-paced, open-entry, open-exit fashion.

In the case of instruction, Control Data Corporation's

PLATO/BEST programmed instruction is widely used, as are a series of programs run on Apple, IBM, Sony, Texas Instruments and other personal computers and on the networked mini-computer-based systems provided by Computer Curriculum Corporation (CCP) and WICAT.

In the 1990's, technology-assisted instruction for adults will be more interactive than much of today's products. The OTA report defines interactive as "technologies that can respond appropriately and quickly..."12/ The point is that the student must do something positive for instruction to proceed; a very different experience from a passive lecture or videotape that plays on whether or not the student is tuned out. A good teacher, in a one-on-one situation, would qualify as interactive. Interactivity enables self-paced, competency-based instruction; it empowers the student, and the receptive teacher.

The 1990's technology will be multi-media. Multi-media refers to the use of more than text; multimedia technology employs graphics, sound, pictures, and (optionally) running video. Combined with interactivity, technology allows the student to see, hear and do. Retention and motivation are increased; instruction is more efficient (i.e., quicker) and time at task is increased. In the 1990's, transmission devices such as satellites, television, and optical

technologies, such as videodiscs and compact discs (CD's), will be employed widely to provide multi-media, interactive instruction.

As a book frees authors from time and place, so does technology-based learning multiply the capacity of superior teachers, allowing them to teach thousands. The multiplication --over time and distance -- affects the economics of instruction by increasing the denominator of the unit cost calculation. Technology also provides instruction with logistic freedom. The economics of conventional instruction leads to large classes which, in turn, requires a rigid schedule. Technology enables individualized instruction -- thus, open-entry, open-exit and student-determined schedules.

Computer-based technology also provides the ability to measure system effectiveness as well as student performance. The system, as well as the student can thus "learn." More efficient programs and systems can be developed based on program data.

Technology is more than hardware. It includes software that enables the instructional designer to use new concepts of artificial intelligence, expert tutors, and hypertext. Students who lack functional literacy deserve the benefits of these concrete results of cognitive science.

The software enables exploratory learning, where a single course serves multiple purposes. That is, a course on statistical process control (SPC) might take a student 4 hours or 200 hours depending on the student's literacy and grasp of the concepts. The lower literacy student would, however, learn more than SPC.

The instructional technology of the 1990's will go well beyond the standard (passive) broadcast or taped TV (such as "Sunrise Semester"), old fashioned "drill and kill" computer-based instruction as developed in the 1960's and 70's, and most of what was available a decade ago. As presently delivered, PLATO, the forerunner of computer-based instruction and Apple II programs that are the most popular in today's K-12 environment would be excluded from the 1990's standard because they are not multimedia.

Today's interactive videodisc arrangement (IVD) is close to a 1990's system. The hardware may either stand alone or be networked to a more powerful personal computer (i.e., a file server). The industry standard is the IBM Infowindow used with a PS/2-25 or more powerful machine (or a PC-clone). This configuration provides a touch-sensitive screen on a high-resolution color monitor and allows the instructional designer to mix (overlay) computer graphics or top of the video image. In addition, wordprocessing

equipment is needed so that the student can produce his/her own work.

Box 1 [Touch me, Feel me] describes Skillpac, one application of IVD technology to improving adult literacy; PALS is another. Even these products would require enhancements (e.g., computer-based record-keeping to guide course improvements) to qualify as a true 1990's approach.

Apple, with their Macintosh machine and the development of Hypercard, should be a strong competitor to IBM's InfoWindow once Apple develops the technology to overlay graphics on a video image.

By 1990, compact disc (CD) technology and more powerful microcomputers using the 386 chip and having substantial hard-disc capacity will be in widespread use in business offices and could be effectively deployed in adult education. The Department of Labor recently funded a small pilot in Baltimore to test the addition of CD to IVD technology to test customization of existing courses. (Skillpac will be customized to teach office skills to welfare-recipient residents of public housing.)

Steve Jobs, originator of Apple, has just announced the NEXT system for college students. NEXT exemplifies the 1990's approach. Figure 4 represents the hardware and basic operating software that the service providers will have to buy or lease, if technology is to be used.

Touch Me, Feel Me

"PLEASE INSPECT the shipment and call me back," prompts an actor addressing two adult students sitting in front of a video screen. They comply by comparing pictures of tools and other items shown on the screen to an invoice.

"How many parts did we get?" the actor continues, "Is the shipment complete?" The students respond by touching one of several numbers on the screen.

That answer determines the next image the students see (video, computer graphics, text, or all three) and the next voice they hear.

"It's the modern way to learn English," said one student in her fifties, pleased by her ability to control the pace and sequence of instruction.

The technology is interactive laser-videodisc (IVD). The pictures of the tools, the sound of the actor's voice and the video vignettes all come from a laser videodisc that looks like a large version of a compact disc but carries visual as well as audio information. Each side of the videodisc carries 54,000 still frames or 30 minutes of running video.

A personal computer, after receiving input from the touch-sensitive screen, directs a laser beam to specified frames on the disc. The computer can also superimpose graphic images on the video image coming from the videodisc player. Thus an arrow may point to a diagram of a pump just as a live instructor points to an illustration in a traditional classroom.

"The gasket is here," says the voice, which is synchronized with a graphic pointer. In both the live and IVD modes of instruction, students are later asked to point to the gasket and explain its function.

One difference between the two courses is that each IVD-student is called on to answer every question. Another difference is the student's absence of embarrassment as the IVD patiently and privately corrects wrong answers.

The computer program that controls the process "knows" what is on the screen and where the student has touched it. The computer program, the videodiscs and accompanying written and audio-taped materials constitute IVD course materials.

I have produced an IVD course called "Skillpac" for adults who are not native speakers of English. Students learn the upgrading skills needed to place an order over the phone, use a maintenance log, compare two personal computers and solve other common workplace problems. Hundreds of other IVD courses are available. One teaches basic literacy to non-readers; others show doctors how to diagnose ulcers, executives to manage, pilots to fly.

Evaluations show that IVD reduces the time required to learn by 30 percent and more in most cases. Retention is increased. Students are motivated because the medium is exciting and because they control the pace of instruction.

Although most courses cost $200,000 or more to develop and the equipment costs $5,000 to $10,000 per work station, the technology is often less expensive then alternative means of instruction. If 2,000 or more students use the same course, the $200,000 development cost is only $100 per student. A $6,000 work station, used for 3,000 hours over a five-year period, works out to a dollar an hour.

—Arnold Packer

Box I

The Technology

Figure 4

Chris Rea, who was involved in marketing PALS for IBM, likens basic literacy for adults to intensive care in the medical system. These students have not fared well with the traditional school system. Remediation on the cheap is not fair or effective. The technology used -- hardware and software -- must be appropriate to the task.

All the hardware and operating software is meaningless without appropriate courseware. Thus, NEXT will not contibute to workplace literacy until courseware is developed. Courseware is analogous to software packages for the personal computer (PC) market. Without word-processing, spreadsheets, and accounting packages all the chips and bits would be useless. These are the razor blades for the razors produced by Apple, IBM, CDC and the others.

E. Instructional Design: Courseware

Technology raises the ante for instructional design. A course that cost a million dollars to produce and that will be used by a 100,000 students better be pretty good. Adoption of technology forces careful consideration of which skills are basic and how should they should be taught. The instructional designer must have more guidance then "the literacy needed to lead a full and productive life....etc."

The skills areas illustrated in Figure 5 represent clusters of occupational skills needed by significant

portions of the 25 million who require skills upgrading in the next decade. These clusters represent "the workplace context" for adult workplace literacy courses. The assumption is that a small number of domains, between ten and twenty, defines enough of the job contexts to be sufficient. Typical domains are "Office Work," "Health Care," "Construction." Figure 5 corresponds to the ten domains and the sorts of knowledge needed in each which are contained in Table I (described in subsection A). Context-driven course materials deemphasize the importance of academic-based tests, such as the GED, TABE, etc. Their premise is that humans are problem-solvers. Thus, the instructional design starts with typical workplace problems and teaches the skills needed to solve them. The relevance to job seekers and employers will be obvious. The skills taught must, however, be transferable. For example, the invoice that had to be interpreted to solve the shipping room problem describe in Box 1 is representative of a class of business documents. All such documents carry a number so that the document can be filed and retrieved. Most identify one or both parties to the transaction, unit prices, total amounts, etc.

Theoretically, technology can make each course useful for various classes of students: ESL, native Americans who read at the fifth-grade level, and so on. The computer is

capable of switching instructional style depending on the language, learning style, and literacy of the student.

F. Summary

1. Most U.S. adults are beyond the decoding stage. They need skills upgrading for context-relevant problem solving; i.e., how to use the information they receive via manuals, reports, documents, computer screens, etc. to solve problems on the job.

2. The skills gap for the 1990's affects at least 25 million persons. On average, workers need to increase their skills from a level of 2.6 on the DoL scale to 3.6.

3. A variety of public (ABE, JTPA, etc) and private programs fund adult basic skills instruction. Instruction is delivered by service providers that may, and often do, receive funding from more than one program.

4. Technology for adult basic skills training in the 1990's means interactivity, multi-media and sufficient record-keeping so that the instructional methodology improves. The technology is useless without courseware appropriate to providing the specified upgrading skills.

Job - Cluster Courseware

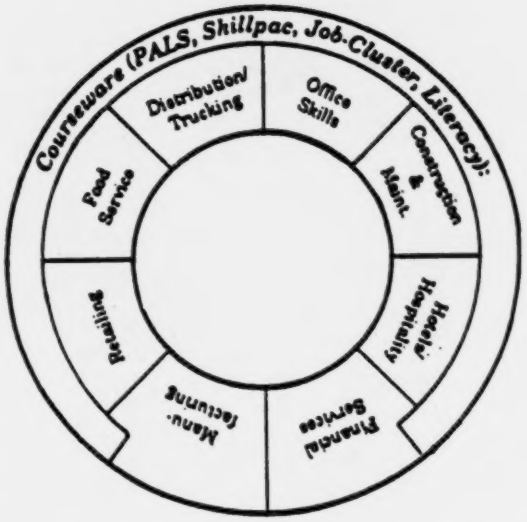


Figure 5

III. TECHNOLOGY IN AN "OPTIMUM" SYSTEM FOR ADULT BASIC EDUCATION.

What are the characteristics of an "optimum" system for adult literacy? Optimality, like beauty, is in the eye of the beholder. There are four points-of-view to be considered: the adult student, the director of the service-provider organization delivering the instruction, the director of the federal agency funding and administering the program, and the senior policymakers in the executive branch and Congress.

Each decision-maker compares perceived costs to benefits. The pertinent question for each of the four decision-makers is: How does technology change the balance between cost and benefits?

A. For the Student:

Unlike schoolchildren, most adult students decide for themselves whether or not to enroll and then complete a course of study. Even when sanctions apply (e.g., under some welfare programs) students must be motivated to apply time-at-the-task of learning. Without a positive decision on this score nothing else matters. Unfortunately, the failure of current approaches is writ large in just these dimensions. Many functionally illiterate adults were high school dropouts. One of every three Hispanics high school students drops out before graduation. More of the same is

unlikely to be a successful remedy.

Analyses of adult basic education must begin with the students and their motivation. Many adults who need to upgrade their basic skills refuse to sign up for "literacy;" often called "dummy" courses by blue collar workers. The drop out rates of those who do sign up are quite high, 30 to 50% and more. Courses that require 200 hours are prescribed to obtain a GED; but most students leave after 35 hours. Yet the GED is often "preparatory" to obtaining the skills training that the student truly wants. Students face, for one more time, the system sabotaging rather than serving them.

The rational student compares the cost of tuition, time, travel, day care and other expenses -- and hassle, embarrassment, etc. -- to <u>perceived</u> pay-offs in better jobs and higher salaries. Does technology reduce any of these costs or increase the perceived benefits?

If the student has to pay for the technology in higher tuition then computers should be added until the additional <u>net</u> cost is just equal to the additional net benefit. (Thus, the economist's concept of optimality is satisfied -- at the margin, costs and benefits are equal.) If the student's tuition is fully subsidized then, from the students' point of view, technology should be added until it has no further beneficial effects -- cost, to the fully

subsidized student, is irrelevant.

The importance of the students' point-of-view is worth repeating. But which student? Figure 6 illustrates a categorization based on the students' connection to the larger economic system. The top half of the doughnut refers to the employed. Some work for big companies, some are members of unions, some work in the public sector, and so on. Some fall into two categories (e.g., they work for unionized small firms). Each category faces a somewhat different cost-benefit calculus; e.g., some pay tuition and others are paid to attend training. Training at the job may not incur transportation costs, etc.

The bottom half of the doughnut applies to the unemployed. Here a government responsibility often applies; e.g., for those on welfare or in prison. Or the student may be eligible for training under JTPA or other programs. Often the demarkation between the upper and lower halves is fuzzy. For example, employed, but about to be terminated, workers qualify for the new Worker Adjustment Assistance Act (Title III of JTPA). Employers of other JTPA eligibles can take advantage of on-the-job (OJT) payments. Of course, the ABE program takes students who fit none (or all) of the other categories. Each group in the bottom of the doughnut also faces a different calculus; e.g, transportation, day care and opportunity costs are low for the incarcerated.

Technology changes the cost calculus for students in most of the doughnut's segments. Distance learning (where the instructor is at a distance from the student) implies scheduling flexibility which can reduce commuting and day-care expense.

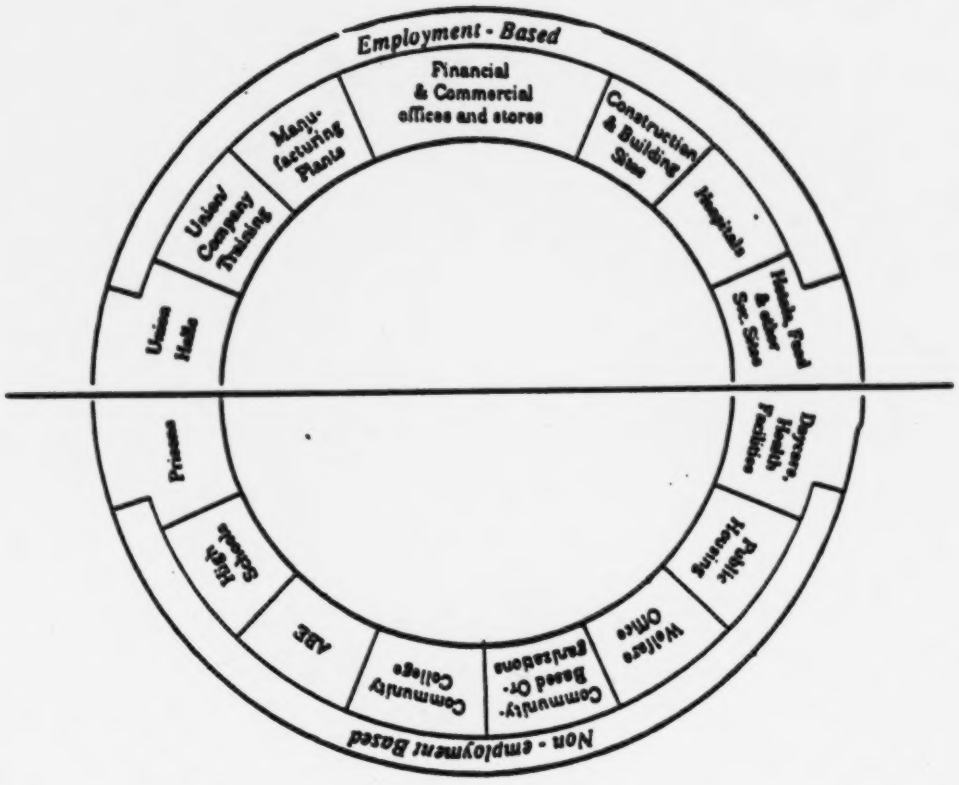
Quicker achievement is another advantage that technology offers the adult student. Evidence from the military and industrial experience suggests a time savings of 30 to 50% over traditional instruction. This reduces costs of commuting, day care, etc., but, even more important, shortens the wait for "graduation" and its benefits of skills training or a good job. In economics jargon, the students' opportunity costs are reduced.

As important as technology is for student costs, the changes in perceived benefits are even greater; perhaps because technology can provide relevant, competency-based, individually-paced instruction. All the evidence suggests that technology is motivating for adult students and that they prefer it to other methods. For example, students judged SKILLPAC, an interactive videodisc course used for English as a Second Language training, as worth 3.6 on a scale of one to four.

Tom Sticht and Larry Mikulecky, two of the most insightful researchers in the field, emphasize the importance of instructional relevance for adults. Indeed,

Student Linkages to Instruction

Mostly Employed



Mostly Unemployed

Figure 6

researchers no longer even debate the issue. ABE teachers try to comply with the call to teach in context, but its not easily done without technology. Up until recent years, most print materials were written for children. Even today, it is difficult for most teachers to assemble materials that will be of interest to the variety of adults that may be in any single class. The relevant work experience of the teacher is also limited; how many ABE teachers know statistical process control or how to use a FAX machine? Yet, literacy taught around these ideas are relevant, interesting and beneficial to students who want to work in a factory or office. Technology, especially when video is used, is a potential way to bring the modern office to the student. A single videodisc contains 54,000 frames or pictures. Each picture can show a different piece of equipment, business form, etc.

Table III lists benefits and cost savings that students may gain from an appropriately designed technology-based course of instruction. But technology is costly. As previously noted, if their tuition is paid by their firm, union, or a government unit, then students will not pay much attention to the costs (unless some sort of voucher arrangements are used). Thus, a different set of decisionmakers need to considered; the service providers who administer instructional programs.

TABLE III

COSTS AND BENEFITS OF ADULT EDUCATION TO THE ADULT STUDENT

COSTS

-o- Time - Many are eager to get through "preparation" and on to the job they want.

-o- Transportation - Both expense and the time/hassle involved.

-o- Embarrassment - It is awkward to be in an adult literacy course. Many of these students disliked school and are not eager to return to class.

-o- School is hassle, registration, keeping to a schedule, putting up with rules, etc.

BENEFITS

-o- Entry into skills training or a good job.

-o- Feeling of dignity and self worth, better parent, and citizen.

-o- Ability to cope with life's other challenges -- leases, insurance, welfare, etc.

B. For the Service-Provider Director:

James Figueroa, Assistant Superintendent, Division of Adult and Occupational Education for the Los Angeles Unified School District (LAUD) is a director of a local service-provider organization, albeit a very large one. Figueroa has responsibility for over 400 thousand students a year and expects that LAUD will be serving adults in the year 2000 and beyond. He receives ABE and GAIN (California's welfare reform) funds from the state, and immigration and JTPA funds from the federal government. Private companies requiring customized on-site programs are also LAUD clients.

Abel Ortiz is another service-provider director; he runs a SER center in Milwaukee and serves clients from a number of programs. SER is a national community-based-organization (CBO) serving the Hispanic community and others. Unlike Figueroa, Ortiz serves only a few hundred students and survives on soft money. Like Figueroa and many local service-providers, Director Ortiz serves many funders.

How do Figueroa and Ortiz and other directors decide about technology? An unfettered service-provider director (with a good MBA) will want to add technology until the benefits equals the cost of the next marginal unit. Ideally, he or she compares the cost of additional resources to the appropriate measure of benefits. In a purely private-sector situation, costs are compared to profits; in

the public-sector, the benefit may be the number of students completing over a multi-year time horizon.

In the real world the director wants to avoid bureaucratic hassle, risk of failure, and other problems. From a policy point of view "other problems" may be most important; for example, will technology purchases appear in the capital or expense budget?

What does the word "expensive" mean in this context? If capital purchases exceeding $10,000 invoke a major budget review process then $10,001 is expensive. In economic terms, however, if a $10,000 technology purchase can increase the number of course-completers by 100 students (i.e., $100 per addition completion over the five-year life of the equipment) then it may be inexpensive (especially, if the cost per completion is $500 with conventional instruction). Policy and procedures are inefficient if they prevent the director from applying this economic calculus when deciding on the use of technology.

The optimum system -- from the service-provider point of view -- occurs when the total cost per unit produced is minimized. Before the calculation can be made someone must decide what the production unit is: hours of instruction, competencies achieved, course completions, placements, etc. This decision frequently is the province of the director of the federal or state agency responsible for the program.

The determination of the unit, for the unit-cost calculation, is often the most important decision made.

C. For the Agency (Program) Administrator.

Agency administrators are those responsible for the federal ABE, JTPA, welfare (specifically the JOBS part of welfare reform), and other programs. Agency administrators want to keep the press, the White House, the Congress, the interest groups, and their staff and their Cabinet Secretary off their back about their program. Agency administrators, therefore, frequently choose a "take no risks" strategy. Ideally, however, they compare the costs of the program -- e.g.; the ABE or JTPA budget -- to Congressionally mandated measures of effectiveness; -- e.g., increased literacy in ABE or placements in JTPA.

Ideally, the agency administrator will enable the service-provider to spend more for hardware, course materials, implementation, and R&D if technology improves performance per dollar spent; i.e. if technology increases the "bang for the buck." Making the cost/benefit calculation is no easy matter and varies considerably among agencies; especially when an investment in technology is involved.

If the decision-maker (at the provider or agency level) cannot spread investment costs over the years in which the

technology will be used, then investment will be discouraged. This is one of the reasons that much of the technology purchased for JTPA comes from special funds: foundations, governor's discretionary 8% funds, demonstration funds and other sources that are not subject to the usual rules, such as the placement-per-dollar in the current year performance standard that applies to most of JTPA. Existing incentives favor spending for current operations rather than investing in improving future system performance. Indeed, there is no capital budget in most of the adult literacy programs.

Other flaws, beyond the lack of a capital budget, impede investment in system improvement. The question of who bears costs and reaps benefits is crucial in a decentralized system of adult basic skills instruction. For example, innovative technology-based instruction can produce greater gains in basic skills in less time than traditional instruction; saving the students' time and costs of transportation, day care, etc. The significance of this advantage depends on who reaps these savings. If the provider is paid on average daily attendance (ADA), as they are in California, for example, will providers invest in technology that reduces the days of instruction required?

Another key problem is the denominator the agency director use in figuring out unit cost; i.e., cost per student, per instructional hour or what. Assume that the agency is going to finance the production of the ultimate interactive videodisc course for basic skills at a cost of a million dollars. If the director "knows" that the course will be used by 100,000 students annually for the next 10 years than the investment is only one dollar per student (i.e., a million dollars for a million students).

This example may be quasi-realistic for, say, the Department of Defense's (DoD's) training agency. DoD decides on its own curriculum and can mandate methodology. This ability to control the instructional process may be the reason why DoD is a leading user of training technology. For the agency director of a decentralized program, however, the amount of use may be unknown, the time horizon will be shorter, and other factors will intrude. Despite the estimating difficulties, it is important for the agency director to think about how many students will be affected and what technology will do to the cost per unit of effectiveness. As was the case for service providers, technology should be added to minimize the cost per unit; i.e, until the marginal cost equals the marginal benefit over some relevant number of years.

In this context a million dollars may be cheap or expensive. If the nation adopts a goal of training 25 million persons during the 1990's, then a course used by ten percent of all trainees could be cost-effective even if it cost $25 million. Whether 25 million is the right goal is another question; one that will be answered by the White House and Congress.

D. For the Administration/Congress.

Most readers appreciate the variety of political, economic, and other factors that determine the positions taken by any administration and Congress on the question: What is the size of the "optimum" adult literacy system? Unlike the agency director, the entire literacy system is of concern at this level of government. An economist, looking only at efficiency, would say - "increase the number of students until the marginal benefit equals the marginal cost."

The economist would compare the increase in the federal budget to the increased payoff in economic (e.g., increased productivity) and non-economic (e.g., decreased social dysfunction such as dropouts and welfare) benefits. The economist might recommend that the lower cost cases be handled first. If that recommendation were followed, then each additional student would be more expensive to

remediate. The economist's approach might exclude the learning disabled.

Another approach would be to seek equity; "provide an equal chance for all, but do so at minimum cost." The argument over education for the developmentally disabled applies here; i.e., ethics, not economics, counts most and everyone should be given full opportunity. Either approach may recommend technology. Technology, if it reduces the cost per student, will increase the number of students that the economist would recommend and allow the equity advocate to operate with a smaller budget.

Clearly, the world is more complicated than these simple situations suggest. But the principle of looking at unit cost, not total cost, remains. The total cost must be divided by the relevant unit: e.g., number of students who completed the course, number of increased placements, or number leaving welfare. Current arrangements make procedural factors more important; how will costs be separated between different programs, is it a capital expense, and so on.

The question may be differently posed: Can we reach the goal of successfully upgrading the basic skills of 25 million students in the 1990's without technology? The current adult system enrolles more than 2.5 million annually but the results are unsatisfactory. The policy issue is

whether technology can cost-effectively improve a system plagued by high drop-out rates without excessively increasing the cost per student. Can more quality -- achieved through technology -- lead to lower costs per successful student?

E. What are the Elements of Cost and Effectiveness for Technology?

The decision to invest in technology should be made after costs and benefits are examined for the adult literacy system. The system goal is an optimum strategy for a cost-effective way to enhance the literacy of adults. System performance, however, will depend on the decisions of students, service providers, program funders, and the vendors who supply hardware, courseware, and other services. Achieving an optimum system will depend on the rules and incentives affecting these individual decision-makers.

Many discussions of technology-supported instruction give more attention to performance than to cost; yet, cost is the most-often mentioned barrier to technology. How should cost be considered; what is the target price for any configuration? Appendix A illustrates a sample calculation that compares the cost of instruction delivered by traditional means to instruction delivered with the support of technology. The sample calculation shows that each computer can "save" students $72,000 and providers $60,000

over the life of the machine if the computer can reduce the time required to achieve a given level of competency and a host of other conditions are met. (For example, the computer will serve two students simultaneously and will operate for 6000 hours. An even more important assumption is that the instruction is teaching something that will be truly useful to the student in the workplace.)

These are the factors that should be weighed when technology is considered. Policies that replace these economic concerns with bureaucratic problems need to be reevaluated. At the margin, technology should be added until the additional cost equals the additional savings to the provider (or provider plus students).

Cost effectiveness calculations must acknowledge that the costs of technology are not limited to hardware and course materials. The costs -- and the success of the technology transfusion -- depends on implementation. Technology is not implemented in a vacuum; success does not come from adding a computer to every class or replacing teachers with machines. Usually, technology changes the system. Airplanes are not faster autos, nor are autos only horseless carriages. Both require an infrastructure, new kinds of workers, and most importantly, a different way of thinking about transportation.

The changes from the successful use of the electronic medium are profound, in the office or in education. Paul Strassman, ex-vice President of Xerox, writing about "The Transformation of Work in the Electronic Age," warns that: "The system should fit people, not the other way around."13/ He advises that successful adoption of technology, in any environment, requires changing the way work is organized and training, training, and training.

F. Summary

1. The ultimate customer is the adult student; the goal is to empower and motivate the student to acquire basic skills. The cheapest approach is unlikely to be best. The doughnut of figure 6 illustrates some of the diversity of the adult basic-skills student. Each group may require a different marketing strategy.

2. Local service-provider directors usually decide on technology. Their decisions will depend on the rules and incentives under which they operate, which in turn depends on the number of pieces of the doughnut that the provider serves, the size and expected life of the program, and the leadership strategy of the director.

3. The federal agency administrator is concerned with the national program but only with one segment of the doughnut. The director should consider technology in cost per unit of

effectiveness -- not total cost, cost per student, or cost per student hour of instruction.

4. The Administration/Congress must look at the entire doughnut and the total national interest when considering cost per unit of effectiveness. They must take a total systems approach.

IV. A TECHNOLOGY-BASED SYSTEM FOR THE 1990'S

A. In What Direction Will the Horse Be Going?

The adult literacy system described in this section will be an expensive investment. It will require funds, leadership, and a commitment to change in both the public and private sectors. It is only likely if the times are right, both politically and economically. Why should there be a major investment in human resources of the "forgotten half;" those who, by and large, did not go beyond high school?

Part of the answer is the macro, or big picture. Major policymakers, corporate and public, must feel that the problem is worth their time and money. Hudson Institute's Workforce 2000, essentially a call to prepare for the new challenge, received much more attention than the authors anticipated; clearly it fell on receptive ground.

Moreover, Workforce 2000 was shortsighted. By 2010, the oldest babyboomers will be 64 and the retirement rolls will begin to swell. (The current average retirement age is 62 and falling). Unless the productivity of those in the labor force increases, the U.S. standard of living will decline.

The trade bill and its host of human resource provisions -- partnerships for literacy, worker

readjustment, training technology transfer -- are political responses to the issues of productivity and competitiveness. The plant closing legislation is another. Candidate (and now Vice-President) Quayle's emphasis on JTPA is a third. Even the new welfare reform bill responds to the call for education and training. Other efforts abound, from the media coverage of ABC and PBS in PLUS (Project Literacy U.S.) to the lower-profile work of the new first lady.

These are the macro, politically-sensitive issues. How will they impact individual companies, unions, and workers?

Of course, the CEO's of the Fortune 1000 read the papers and will look for the problem within their own workforce. Human Resource departments in some manufacturing (e.g., autos) and service companies (e.g., hotels) already recognize the literacy problem as one they share. Domino Pizza, after successfully completing a videodisc course for literacy related to making pizza dough, is now engaged in a joint effort with the LA Unified School District, to produce a second IVD course. The new course will teach literacy and ESL related to customer service.

The recognition will come more rapidly where unions strive for the same ends. Thus, the auto companies are leaders because they and the UAW have created "nickel funds." These funds, now financed by considerably more

than a nickel per hour worked by UAW members, are used by National Training organizations for basic skills (and other) training.

AT&T, and it CWA and IBEW unions, have similarly created the Alliance, to collect and disburse funds for retraining unionized workers at AT&T. Morty Bahr, President of the CWA, is outspoken on the literacy issue. A consortium of 8 unions in New York have formed a Consortium for Literacy, and are using interactive video in one of their training sites.

The literacy problem, however, lies more with small firms than with large. Unless employees in small companies are upgraded, the 25-million goal will not be met. Data from a recent SBA report14/ indicate that small firms hire most entry-level workers and often pay less and employ the least educated. Fewer small firms then large have Human Resource departments or training activities; their workers tend to be more mobile and, thus, the employers have less stake in them. Who has a stake in these workers?

Some of the best training in the world has come from vendors. IBM trains PALS teachers and historically has trained users of their mainframe computer equipment. For many years, Ford donated cars to vocational education schools and they, and other manufacturers, still do. Seed

companies have trained farmers and auto companies train their independent dealers. Training often works best when the training organization has a stake in the outcome.

Products are becoming more technical, from telephones with multiple features to complex insurance and financial instruments. It is difficult to sell high-tech products to a low-tech workforce. The marketing departments of many Fortune 1000 companies have an interest in the workplace capacity of their customers. Untrained small suppliers are also a problem to large firms; therefore, the auto companies help their vendors learn statistical quality control. Bankers have a stake in the financial literacy of their borrowers. Thus, large firms that sell to, buy from, or lend to smaller companies have an interest in solving the problems of illiteracy in the workforce.

Upgrading the nation's workforce is a systems problem that effects many parts of the private and public sectors. In many cases, it will require unprecedented cooperation among public agencies and private firms, between companies and their unions, and between large firms and their smaller customers and vendors. This cooperation can best be accomplished with technology and technology-based courses as described in the next two sub-sections.

B. Getting from Here to There.

Current demonstration programs, funded by the U.S. Departments of Labor and Education and by private foundations (especially the Ford Foundation) have provided a start towards a technology-supported system. The demonstrations have also uncovered some obstacles to quick progress. A minimum of a year was needed between a decision to proceed and true operations at a single provider site. Changing a multi-site service provider (such as SER, a service to the Hispanic community) takes twice as long.

Progress to date has just scratched the surface if the goal is upgrading the basic skills of 25 million workers in the 1990's. The build-up of capacity is limited by the funds available and the difficulty of training and reorganizing instruction around technology. Yet, a solution is within reach if prompt action is taken in 1989. Two possible schedules for transforming the system are given below in Table 4. The total investment is a function of total system capacity; the investment in any year is a function of the increase in capacity that year. Alternative A has the higher single year costs (1993 and 1994), while alternative B has a higher total cost. At an investment cost of, say $1,000 per student in hardware, software, space modification, furniture, teacher training, etc.; the investment cost of alternative A is $3 billion with $1.0

TABLE IV

SYSTEM CAPACITY FOR TECHNOLOGY-SUPPORTED INSTRUCTION

(in millions of students)

	1989	1990	1991	1992	1993	1994	1995	1996	1997	2000
A.	0.1	0.3	0.6	1.0	2.0	3.0	3.0	3.0	3.0	
B.	0.1	0.3	0.6	1.0	1.5	2.0	2.5	3.0	3.5	

---

billion required in 1993 and 94. Under B, the total would be $3.5 billion with no more than $0.5 billion in any year. (See Table 6 on page 66 for an example of the calculations.) In addition, there would be replacement expenses after five years or so (i.e., investment costs might be $200 annually/student to replace and upgrade the system). Operating expenses might be another $1000 per student (@ $5.00/hr x 200 hours of total instruction).

Is a system capable of upgrading 3.5 million adults annually going to be too large in the next century? Current estimates suggest that 2.5 million or so functional illiterates enter the labor force annually, either from high school or immigration. System capacity of 3 to 3.5 million would be adequate then to cope with the literacy problem on a continuing basis. The margin of 0.5 to 1.0 million of "extra" capacity, and more, will be needed in the next century as the requirements for "literacy" continue to rise

and American workers seek further upgrading.

C. Visions of the Future Beyond 2000.

In the next century, better courseware -- that includes artificial intelligence, expert tutors, more complex simulations, and more reliable tests -- coupled with better technology -- lower-cost and higher-performance IVDs and CD hardware, and inexpensive downlinks from satellites -- should further improve the cost performance tradeoff. For example, courses that require 300 hours when taught without technology may be reduced to 100 hours.

The early part of the next century will be a great challenge for the U.S. In 2010, those born at the onset of the baby boom will be 64; in 2030, those born at the end of the boom will be 66. The much smaller cohort of workers that followed will have to support the nation, finance social security and other pension and health plans, and carry our banner in international competition. Unless that cohort is much more productive than the workers of 1988 the country will be in great difficulty.

The challenge will not be met without better education and training than we have today. That, in turn, requires effective use of technology. If the next decade is not used to build the system for adult education -- to develop appropriate courses, invest in hardware, train instructors,

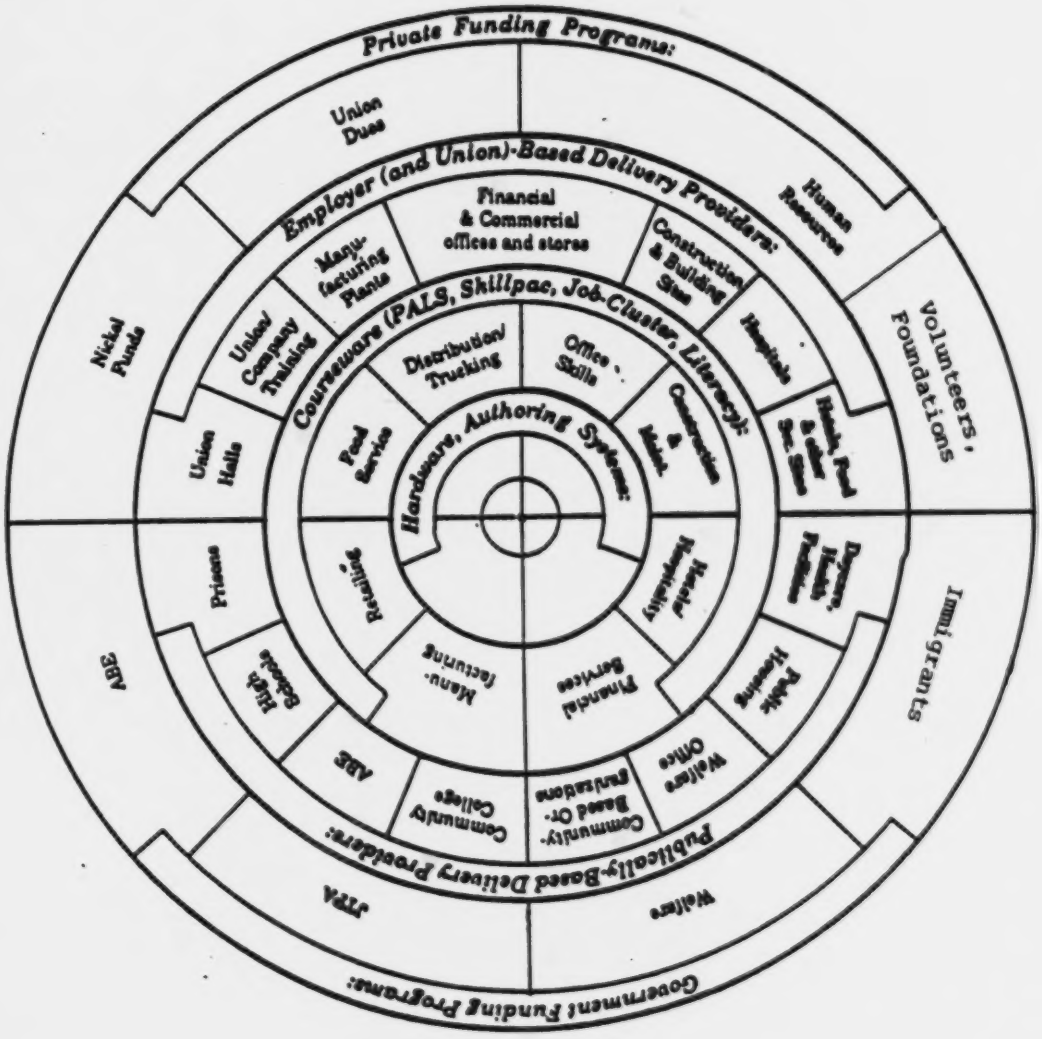
build instructional arrangements that use technology effectively -- the game may well be lost.

D. Summary

Figure 7 brings together the doughnuts of figures 2 through 6 to depict a flexible technology-based system. Combinations of hardware and software would be made available to service providers who serve a combination of funding organizations and a diverse student body. This implies course materials that are "transportable" across different hardware or service providers having different hardware systems because they want IBM's PALS and some Apple-based courseware. It also implies service providers with the flexibility to invest in technology and to use the investment to serve clients from different programs in the same class.

A total investment of approximately $3.5 billion -- for hardware, software, teacher training, furniture, etc., is needed to create a literacy system as depicted in Figure 7 and that can serve 25 million during the next decade. This can be accomplished by spending $300 to $500 million annually. What should the federal government do to bring forth those funds and see that they are wisely invested in the nations's literacy system?

A Technology-Supported Literacy System



Select a solution: Each of the four rings rotates separately to produce a winning solution.

Figure 7

V. THE FEDERAL ROLE

As 1988 ended the federal role in training technology was...confused. While some federal programs encouraged its use, some features of other programs discouraged the spread of technology. For example, a few provisions in 1988's and the new programs for the disabled and military training programs acknowledge the existence of technology. On the other hand, the absence of multi-year arrangements with providers and stringent eligibility rules in JTPA discourage adoption of technology. Generally, programs for adult education -- whether funded by DoL, DoE, or HHS (WIN and the new welfare reform) -- lack a capital budget. Nor do these agencies fund research and development in technology.

The technical expertise within the agencies (with the possible exception of DoE) is inadequate to develop policy regarding technology. Both DoL and HHS should establish and staff a Technology Office. The staff should know software and hardware and be competent to provide technical assistance to those in the field who want to enter the technology era. These Offices should understand the issues well enough to provide policy guidance to senior policy-makers in their agencies.15/

Initially, the Offices should examine policies in two categories:

-o- elimination of barriers at the service-provider level,

and

-o- positive encouragement at the national level.

A. Removing Barriers.

Most service providers believe that the 1990's technology -- e.g., a PALS lab with four InfoWindows for $60,000 -- is "too expensive." Yet, these are multibillion dollar programs which, in many years, have had trouble spending all of the appropriated funds.

What is wrong? Why don't service provider managers make the cost calculations described in this paper. Even if there were good validated course materials and successful projects, would technology be adopted as "efficient markets" would indicate? Most likely not.

The most frequent response is that such funds would come at the expense of services. In many places there are waiting lines. The waiting list for ESL training in the L.A. Unified District is 20,000 and growing. "Do we want to turn away students by sending teachers to training? Who will cover their classes? We don't have training (or technology) budgets."

L.A. Unified is a case in point. They have 300 thousand adult ESL students. One dollar a student would finance the

development of a good ESL course, yet it is an unlikely investment. Why?

A partial answer may be found where technology has been adopted. CCP, CCC, and PALS are three examples. The money often came from an irregular source -- the Ford foundation, Governor's 8% (of JTPA) funds, or the vendor either gave or financed the purchase. Remarkably, even when technology is provided from irregular sources, such as a foundation or a nationally-funded R&D project, the needed accessories -- training, furniture, etc -- are "too expensive."

The solution requires a new philosophy that emphasizes investment, in both students and the instructional system and flexible use of technology. Operational definitions and the six policy implications of the philosophy are described below.

1. Invest in Students.

Adopt an investment mentality regarding adult basic skills students by providing quality education and training. Do it right the first time or, for adult students, the second. Looking for the cheapest, lowest cost per student hour of instruction is stupid if the same students are back next year to be re-re-trained. This implies searching for better measures than placement per dollar or cost per instructional hour. Better no measure than these misleading signals.

Edwards Deming is the father of statistical process control, first in Japan and now in the U.S. His fascinating book, Out of Crisis 16/, should be required reading for any government (or private) standardmaker. Training-system performance should be measured, statistically, by the difference it makes in the lives of those trained. Only good jobs (or, at least better than jobs that could be gotten without basic skills) should count and better jobs should count more. Similarly, the students' starting place should count; the cream of the unskilled crop needs less help than those at the bottom. Better a 1% random sample and a measure of the real difference made in the lives of those served, than a 100% reporting of placement per dollar.

2. Invest in the System.

Investment in staff training (again see Deming); systems changes, experimentation and technology should be encouraged. A simple way to provide encouragement would be a local investment set-aside. An investment set-aside should be available to allow providers to invest in technology and staff training. The set-aside should be excluded from the current-year accountability measure (i.e., local set-aside funds in JTPA would be excluded from today's placement-per-dollar criterion).

A revolving loan fund is an alternative. In this, more complex approach, SDA's or service providers could borrow

for these investment purposes but would have to put the money back or meet a premium performance standard.

Yet another possibility is to provide the set-aside at the local level and allow them to establish a loan fund. The SDA or other local funding agency would loan funds to service providers for specified purposes that meet one or more of the three objectives (i.e., investing in the student, investing in the system, and/or flexible use of technology).

The important point is that some funds be allocated to investing in the system even though, in the short run, the training and technology is purchased at the expense of current services.

3. Flexible Use of Facilities.

Technology pays when equipment is heavily scheduled. Little is gained by buying technology that is only used a few hours weekly. For a temporary program with few students, it is often better to employ a part-time teacher than to invest in major change. Regulations are often a barrier to high utilization of technology because they prohibit the service provider from putting students from different programs in front of the same hardware.

The set-aside or loan program mentioned above could be used for this purpose. For example, a provider could set up

a lab with the loan and serve JTPA students and functionally illiterate employees of a firm for a fee per student; the revenues to be used to pay back the loan.

B. Positive Encouragement.

The policy recommendations above are passive, they remove barriers to a market-like approach. This section notes positive action where there may be a need for a larger federal role. There are six reasons for the federal government to increase its role:

1. To Train Its Own Workforce.

The military is using new methodologies and, indeed, is an important source of improvements in training technology. (The Training Technology Transfer act is part of last year's trade bill. The Act establishes a mechanism to transfer government-financed courseware and other training technology to the private sector. It is an attempt to reap the benefits of DoD's investment in other parts of the economy.)

For the civil service, the Office of Personnel Management should examine the potential of technology to train in office skills. The postal service and the Internal Revenue Service are other possibilities; for example, IRS might develop a course on "tax literacy" that could be used by its lower-literacy employees and in high schools.

2. To Decrease Federal Program Costs.

Federal investment in training may be appropriate in sectors where the government is spending large amounts of money and could benefit from increased productivity. The health sector and defense contractors are two examples that quickly come to mind. Great care must be exercised not to inhibit private sector investment. Last year, Congress mandated training of nurses assistants in nursing homes and authorized the spending of Medicaid funds for that purpose. In response, at least one private sector group has raised private investment funds to develop an IVD course. Availability of a publicly-funded competitor would discourage future private investment.

3. Public/Private Cooperation.

Economies of scale are important in technology-based courses. The federal government could act as a broker to bring together firms in an industry and engage in joint ventures (e.g., the insurance industry and the public sector might work together to produce a course teaching "Literacy and Insurance").

4. Basic Research and Development.

There is a crying need for advances in the cognitive sciences as they apply to technology. Many of the important advances in computer sciences have been financed by DoD. For example, DoD recently announced a major effort to

develop voice recognition technology.

Adult literacy also needs new technological advances; these could properly be financed by the federal government. The government could assist in making courses transportable across hardware, could test whether older adults respond differently than adolescents to certain stimuli, could experiment with expert tutors, etc. It is important in, all these endeavors, to avoid inhibiting the private sector. Inhibitions would arise if the government made a premature selection of a standard for all courses or if the private sector was concerned about the government funding public-domain products.

5. Applied Research and Development.

The agencies should fund more demonstration and implementation programs to prove various models; e.g., technology-supported family learning centers that treat mothers and their children (see the demonstrations in the welfare reform bill). In many cases, federal matching funds are needed if public/private joint ventures (as in subsection 3 above) are to be carried out successfully.

6. Evaluate, Disseminate, and Provide Technical Assistance.

The industry desperately needs advice it can trust about technology, advice that is separate from the hardware (and software) vendors. It needs to know what works and what bombs. The service providers also need technical

assistance, especially if -- as argued here -- the technology requires changes in provider operations. Again, policy must be careful that potential free advice does not discourage a private-sector response to the gap.

The most important of the policy changes could be contained in the proposed Literacy Investment Act described below.

C. The Literacy Investment Act of 1989

The goal of the Literacy Investment Act (LIA) of 1989 is to create a system, during the 1990's, that can efficiently upgrade current workers and potential workers with workplace skills inadequate for the beginning of he 20th century. Groups include those on welfare, workers dislocated by economic change, high school dropouts, immigrants with inadequate English, and others in the so-called "forgotten half. The Act would emphasize long-term investment -- in enrollees who have substantial literacy deficits and in the system that serves them. The LIA would have the following provisions:

1. Provider Flexibility: Any provider of literacy or basic skills instruction that serves one category of student (e.g., JTPA, ABE, etc.) shall be allowed to serve any other category, including employed workers who require upgrading, on a reimburseable basis.

2. Provider Investment: The states or their local agents (i.e., the local Private Industry Council (PIC) for JTPA, the local Education district, the welfare agency, etc.) shall be permitted to use up to 5% of their allocation for investment -- by their service providers -- in hardware, software, staff training, technical assistance, planning, and facilities for use of technology. Agencies should be encouraged to make long-term arrangements with providers so that the investment can be amortized properly.

3. Federal Investment: The federal government shall match the provider investment on a one for one basis (i.e., the federal contribution may reach 5% of the budget for the included programs if every local provider used its full 5% allotment).

4. Full Funding: The authorizing programs (see Table 5) shall be fully funded over multi-year periods and the immigration law extended beyond its schedules expiration date.

5. A National Center for Literacy: A new National Center would have three responsibilities:

-o- basic research in cognitive science and adult learning;

-o- evaluation, including the development of appropriate measures of performance for adult programs;

-o- dissemination of results of research and evaluation, including identification of best practices.

TABLE V

POTENTIAL MAJOR* FEDERAL ADULT LEARNING PROGRAMS

		FY 89 ($bil.)	1990's potential ($bil.)
Labor	TITLE II-A	$1.8	$1.8
	Summer Youth	0.7	0.7
	Job Corps	0.7	0.7
	Dislocated Worker	0.3	1.0
	Subtotal	($3.5)	($4.2)
Education	ABE	0.2	0.2
	Voc-Ed	0.8	0.8
HHS	Welfare	0.1	1.0
Immigration	(IRCA)	1.0	1.0
	Total	$5.6	$7.2

* Programs of $100 million or more. Except for ABE, all of these programs fund things other than literacy/basic skills. (Job Corps, for example, is primarily a residential program and basic education is a small part of the total spent; IRCA provides a variety of services for immigrants.) On the other hand, states and the private sector add to the total. For example, in 1987-88 California received $8.3 million in federal ABE funds and appropriated $220 million in state funds for adult education. (California, which accounts for 40% of the nation's ABE population, is clearly exceptional.)

TABLE VI

SYTEM INVESTMENT REQUIRED

	1989	1990	1991	1992	1993	1994
Capacity a/	0.1	0.3	0.6	1.0	1.5	2.0
Increase b/	0.1	0.2	0.3	0.4	0.5	0.5
Investment c/	100	200	300	400	500	500
Base d/	5.6	6.0	6.5	7.0	7.2	7.2
Local Set-aside e/	3%	4%	5%	5%	5%	5%
Federal Matchup f/	3%	4%	5%	5%	5%	5%
Take-up Rate g/	30%	42%	46%	57%	70%	70%

a/ Capacity in millions of students from Alternative B in Table 4.

b/ Increase in student capacity in year shown.

c/ Investment (in $ millions) required at $1000 per student for teacher training and equipment, software, etc.

d/ Base of programs from Table 5 (in $ bil.)

e/ Legislated maximum for which a federal match is available (see text).

f/ Legislated (see text).

g/ Imputed.

NOTES

1. Packer, Arnold, "Retooling the American Worker" The Washington Post, Sunday July 10, 1988.

2. Power On, Office of Technology Assessment, U.S., Congress, OTA-SET-380, September 1988.

3. Ibid p.4.

4. Hirsch, E.C. Cultural Literacy. Houghton Miffin Co. Boston, 1987.

5. Educational Testing Services' (ETS), National Assessment of Educational Progress (NAEP). Literacy, Profiles of America's Young Adults, Princeton University, 1987.

6. U.S. Department of Labor and Education, The Bottom Line: Basic Skills in the Workplace, Washington, D.C., 1988.

7. One of the literacy audits is a survey of skills needed to be a maintenance worker in a multi-family housing project. The study is being performed by Interactive Training, Inc. in cooperation with the Glick Corporation.

8. Packer, op. cit.

9. Johnston, William B. and Arnold H. Packer: Workforce 2000 Hudson Institute, Indianapolis, Indiana, 1987.

10. For example, there is a joint project, funded by DoE, to produce a videodisc for customer service. The "partners" are the Los Angeles Unified School District and Dominos Pizza.

11. The Job Training Partnership Act and Computer-Assisted Instruction; National Commission for Employment Policy, Washington D.C., August 1988 (Education Turnkey Systems, Inc.)

12. Power On, op. cit.

13. Strausman, Paul, Information Payoff, The Transformation of Work in the Electronic Age, p 93, The Free Press, 1985.

14. SBA Job Training in Small and Large Firms, mimeo, August 8, 1988.

15. DoL recently created a "Center for Advanced Living System" within its Employment and Training Administration.

16. Demming, Edwards W. Out of Crisis, M.I.T. Center for Advanced Engineering Study, Cambridge, Massachusetts 1986.

APPENDIX

Table AI shows the calculation for a traditionally delivered course of instruction that requires 300 hours. The variable (after space, overhead, etc.) cost per student hour of instruction is $5.00. The cost to the student, ignoring tuition if any, is $6.00 per hour for missed wages. Let us proceed, as good economists, to assume a few more things: (a) technology can reduce the 300 hours of traditional instruction to 200 hours of instruction to achieve the same level of skills; (b) two students will use the machine at one time and the machines are used for 100 hours of the 200 hour course; and (c) the machines can be used for 6000 hours without maintenance. (This is a much more useful algebra problem than finding when trains leaving Chicago and New York will cross.)

With these assumptions, how much can technology cost and still improve the efficiency of the system? Cutting 100 hours from the course length saves the provider $500 per student and saves the student $600. Since each machine serves two students, a 100 hours of machine time is "worth" $1000 ($10/hour) to the provider and $1200 ($12 per hour) to the two students. Since a machine can be used for 6000 hours it is "worth" $60,000 to the provider and $72,000 to the 120 students who will use it.

Clearly, many things have been left out; costs of space, training, additional staff, security etc. and, of course, the cost of software and courseware. Moreover, it is unclear whether the provider cares about the students' "savings."

A HYPOTHETICAL COST CALCULATION

1. Traditionally Delivered Course of 300 hours

Provider Cost: 300 hours @ $5/hour = $1,500/student

Student Cost: 300 hours @ $6/hour = $1,800/student

2. Technologically-supported Course of 200 hours

Provider Savings: 100 Hours @ $5/hour = $500

Student Savings: 100 Hours @ $6/hour = $600

Computer Time Required = 100 hours/2 students per machine
= 50 hours per student per course

Courses Delivered in 6000 hours of Machine Life
= 2 students x 6000/100 hours per course = 120

Total Provider Savings per machine = 120 x $500 = $60,000

Total Student Savings per machine = 120 x $600 = $72,000

Table AI

DR. ARNOLD H. PACKER

Dr. Arnold Packer is President of Interactive Training, Inc. The firm produces interactive videodisc training courses (SKILLPACs) to reach basic workplace skills in the U.S. and abroad. The SKILLPAC, "English for Industry," has been used with dislocated workers in Massachusetts and is now operating in test sites in New York City, Washington D.C., and California.

Dr. Packer is also a Senior Fellow at the Hudson Institute and Deputy Director of the Work Force 2000 study. He is currently directing a related project, exploring the use of technology to teach WorkPlace Literacy.

Previously, Dr. Packer held a number of important positions in the executive and legislative branches of the federal government. He was Assistant Secretary for Policy, Evaluation, and Research at the Department of Labor, from 1977 to 1980. There he helped the Administration formulate macroeconomic policy and designed employment and training programs for youth, welfare recipients, and workers dislocated by economic change.

Earlier, he was Chief Economist for the Budget Committee in the U.S. Senate. He held that position from 1974, when the Congressional budget process began, until 1977. He has also worked as an economist for the Office of Management and Budget (OMB).

Dr. Packer holds a PhD in Economics from the University of North Carolina at Chapel Hill. He also has a Masters in Business Administration (from Sacremento State) and a Bachelors in Mechanical Engineering (from the Brooklyn Polytechnic University).

Dr. Packer has written widely about economics, employment and training policies, the use of technology for training. He has also written a book, published by the MIT press, on computer-based models of the economy.